

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

FOREST STAND IMPROVEMENT

(Acre)

CODE 666

DEFINITION

The manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation.

PURPOSE

- Increase the quantity and quality of forest products by manipulating stand density and structure.
- Harvest forest products.
- Initiate forest stand regeneration.
- Reduce wildfire hazard.
- Improve forest health reducing the potential of damage from pests and moisture stress.
- Restore natural plant communities.
- Achieve or maintain a desired native understory plant community for special forest products, grazing, and browsing.
- Improve aesthetic and recreation, values.
- Improve wildlife habitat.
- Alter water yield.
- Increase carbon storage in selected trees.

CONDITIONS WHERE PRACTICE APPLIES

All forest land.

This standard is not applicable for Alley Cropping, 311; Multi-story Cropping, 379, Windbreak/Shelterbelt Establishment (operation and maintenance), 380, and Windbreak/Shelterbelt Renovation, 650.

CRITERIA

General Criteria Applicable to All Purposes

The harvest-regeneration strategy will be identified for all planned forest improvement harvesting:

- Uneven-aged management systems (e.g., single-tree selection, group selection, coppice selection)
- Even-aged management (e.g., clear-cut, seed-tree, shelterwood, coppice)

The extent or size and orientation of treatment area(s) shall be identified as part of practice design.

Preferred tree and understory species are identified and retained to achieve all planned purposes.

Spacing, density, size class, number and amounts of trees and understory species to be retained will follow established guidelines for the intended purposes.

Stocking guidelines shall contain stocking in terms of basal area, spacing or trees per acre by species and size class distribution. [If uneven-aged management is used the appropriate targeted q-factor needs to be identified.](#)

The method, felling direction and timing of tree cutting for harvesting shall protect site resources, e.g., residual trees, wetlands, cultural resources, improvements and utilities. Time tree cutting to avoid buildup of insect or disease populations. Felling direction must be compatible with trail layout as specified by Forest Trails and Landings, 655.

Forest stand improvement activities shall be performed to minimize soil erosion,

compaction, rutting, and damage to remaining vegetation and maintain hydrologic conditions.

Slash and debris will be treated such that they do not present an unacceptable fire, safety, environmental, or pest hazard. Such remaining material will not interfere with the intended purpose or other management activities. Refer to Slash Treatment, 384. Burning of slash and other debris on-site shall follow the standard Prescribed Burning, 338.

Comply with applicable federal, state and local laws and regulations during the installation, operation and maintenance of this practice including the *“Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont”*.

Additional Criteria to Reduce Wildfire Hazard

Reduce stocking rates of trees to minimize crown-to-crown spread of fire.

Remove “ladder” fuels to minimize the occurrence of crown fires.

Further treat or eliminate slash accumulations next to roads and trails.

Reduce or eliminate species with high volatility but not to a level that would compromise other intended purposes.

For additional wildfire risk and damage reduction, refer to the standards Fuel Break, 383, and Firebreak, 394.

Additional Criteria to Improve Wildlife Habitat

Manage for tree species and stocking rates that meet desired wildlife species food and cover requirements.

Create, recruit and maintain sufficient snags and down woody material to meet requirements of desired species in balance with conditions needed to achieve other intended purposes.

Where possible, retain a minimum of 3 actively used den trees or 3 large hardwood cull trees, and a minimum of 5 mast-producing trees such as oak, hickory, and beech on each acre treated. In New England more than 50 different species of birds and mammals use cull trees

as shelter, for nesting, or as a food resource. . Residual cull trees should be counted as part of the residual basal area left after thinning because they continue to impact the growth of the remaining stand. 1/ Also consider releasing apple trees for wildlife.

Minimize improvement actions that disturb seasonal wildlife activities.

Refer to Upland Wildlife Habitat Management, 645, and Wetland Wildlife Habitat Management, 644 to further develop and manage wildlife-related activities.

Additional Criteria to Increase Carbon Storage in Selected Trees

Manage for tree species and stocking rates that have higher rates of growth and potential for carbon sequestration.

CONSIDERATIONS

Silvicultural objectives and harvest-regeneration strategies may change over time and may be limited by prior management.

Successful regeneration of desirable species is usually dependent upon timely application of forest stand improvement and other practices, e.g., prescribed burning, site preparation, tree and shrub establishment, prescribed grazing and use exclusion.

The extent, timing, size of treatment area, or the intensity of the practice should be adjusted to minimize cumulative effects (onsite and offsite), e.g., hydrologic and stream alteration, habitat fragmentation, nutrient cycling, biodiversity and visual resources.

For purposes other than improving wildlife habitat, the practice should be timed to minimize disturbance of seasonal wildlife activities.

Landowners should secure a written contract with any service provider that specifically describes the extent of activity, duration of activity, liability and responsibilities of each party and amount and timing of payments for services provided

Slash, debris and other vegetation (biomass) removed during stand improvement may be used to produce energy. Management alternatives should consider the amount of

energy required to produce and convert the biomass into energy with the amount produced by the biomass.

Clients should be advised of responsibilities of wildfire control and consider the development of a wildfire control plan including “defensible” space, access routes, fire-season water source, and location of wildfire control facilities.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes and narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

Periodic inspections during and after treatment activities are necessary to ensure that purposes are achieved and resource damage is minimized, e.g., assessment of insects, disease and other pests, storm damage, and damage by trespass. The results of inspections shall determine the need for additional treatment under this practice.

ATTACHMENT 1

Vermont Supplemental Specifications

1. WEEDING

- The purpose is to pre-commercially remove unwanted species and favor desirable species.
- Weeding is usually needed the most in mixed stands of conifers and hardwoods.
- When weeding a mixed stand, work toward small groups or patches of pure hardwoods or conifers.
- Used with seedlings and saplings 1" to 4" in diameter and approximately 10 to 15 feet in height. (Conifers may need weeding sooner)
- Stand receiving this treatment are typically between 5 and 20 years of age.
- Minimum stocking for hardwood stands is 200 well-distributed, vigorous seedlings or saplings per acre with an average spacing of 17 feet between selected crop trees. 1/ 2/
- For adequately stocked and spaced softwood stands overtopped by hardwoods, chemically or mechanically release a minimum of 150- 200 crop trees per acre.
- Most softwood stands may be thinned as soon as crowns have closed. In White Pine plantations and fully stocked natural stands, delay release until trees are a minimum height of 20 feet. Once released, White Pine does not need thinning until the stand averages 7-8" DBH.
- Minimum stocking for White Pine and Red Pine is 350 well-distributed, vigorous pine seedlings or saplings per acre. 3/
- On soils with hardwood site indices of 60 or greater, manage as mixed stands favoring groups of pine. Nearly pure stands of pine should be developed where possible on soils with lower hardwood site indices, especially on sandy or gravelly outwash soils or where hardwood site indices are less than 50.
- For protection from White Pine Weevil, retain partial shade for individual stems. Remove only those trees which interfere with sunlight to the tops of the pines. Dense pockets of white pine may be completely released. Light crowned species such as birches, aspens and ashes should be favored over the coarser crowned species such as the oaks and maples.
- Minimum stocking in Unmanaged Spruce-Balsam Fir seedling/sapling stands 1-4 inches in diameter ranges from 850-1660 stems/acre. 4/ Begin thinning when trees are 5-10 feet in height. Favor spruce and other softwoods over balsam fir.
- On somewhat poorly drained soils, nearly pure stands of spruce and balsam fir may be grown with little hardwood control. On better-drained sites, hardwoods must be controlled if spruce and fir are favored. In some cases it might not be economical or desirable to control hardwoods if they are marketable species.
- If Hardwoods comprise more than half of a stand, manage as a mixed stand.
- Weed, (cut or kill):
 - Trees which may damage desired stems.
 - Trees of inferior species or inferior form, irrespective of species which are outgrowing desirable stems.
 - Coarse stems of sprout origin which are outgrowing stems of seedling origin.
 - Vines and overtopping shrubs which are competing with desirable trees.
 - Don't overcut. Weed lightly and repeat the process more often.
 - Do only what is necessary to bring the best trees through the next 5 years.
 - Weed just enough to bring the upper crowns of valuable stems into full sunlight.

- Stands remaining after treatment should be dense to assure self-pruning of lower limbs, straightness and maximum height of stem, and protection against snow and ice damage.

Table 1 (incomplete list) serves as a guide that relates the general soil moisture regime with the preferred, acceptable and weed species on a site. Management objectives may increase or decrease the relative desirability of a species. A professional forester should be consulted for recommendations concerning a particular site.

TABLE 1 - Timber species for varying soil moisture regimes. This table is for timber production only. Many of the species undesirable for timber production are excellent wildlife species.

<u>Group</u>	<u>Dry Sites</u> (a)	<u>Moist Sites</u> (b)	<u>Wet Sites</u> (c)
Group 1 (Preferred Species)	White Pine Red Pine	Red Oak Sugar Maple Yellow & White Birch Basswood Ash Red & White Pine Hemlock Red & White Spruce Norway Spruce	Not generally suited for commercial tree production.
Group 2 (Acceptable Species)	Red & White Oak Red Maple White Birch White Spruce	Red Maple Beech	Not generally suited for commercial tree production.
Group 3 (Undesirable Species)	Aspens Gray & Yellow Birch Pin Cherry Elm Ash Sugar Maple Beech Basswood Hickories Hophornbean Willows	Aspens Alders Blue Beech Elm Pin Cherry Hophornbeam Mountain Maple Willows	Not generally suited for commercial tree production.
(a) – Usually sandy or shallow soils. (b) – Usually loams or deep soils, well drained to moderately well drained. (c) – Usually poorly drained soils.			

- Other general guidelines:
 - Species in Group 2 should be favored if no Group 1.
 - A straight stem in Group 2 would be favored over a poor quality stem in Group 1.
- Group 3 may be used to assure a dense stand, but should be eliminated when they outgrow Group 1 or 2 trees.

2. AREA WIDE THINNING (COMMERCIAL AND PRE-COMMERCIAL)

- The purpose is to remove overtopping trees and provide improved growing conditions for desired species. See Weeding for a listing of preferred, acceptable and undesirable species.
- Thin stands according to the Stocking Guide (Table 2).
- Deviate from these guides when necessary to reduce damage to a stand from insects and disease, exposure (sun, wind, ice, snow), epicormic branching of hardwoods or to maximize cubic volume growth. 5/ 6/
- Physically remove, girdle or chemically kill in place. If chain saw is used, trees less than 6 inches diameter DBH will be completely severed and larger trees will be girdled with a double cut 2-4" Pre-commercial thinnings are often necessary in stands where there is a very large number of trees (1000>per acre) of the same or similar species.
- Pre-commercial thinning is used in stands with trees that have an average diameter greater than four inches, but the trees harvested have no commercial value, either through sale or for use by the owner. 7/
- Commercial thinning is used for Pulp and Sawlog timber, 8" in diameter and larger.

3. CROP TREE RELEASE

- The purpose is to concentrate growth on individual trees intended for harvest in the future.
- Crop trees are chosen for attributes that meet management goals and are given a crown touching release. All trees touching the crown of the crop tree are removed.
- The difference between area wide thinning and crop tree release is that in area wide thinning, tree removal is dictated by stocking levels, such as those in table 2. In many cases high quality trees are only released on 1 or 2 sides. Crop tree release focuses the majority of harvesting around selected crop trees. Releasing all four side of a selected crop tree ensures that it has all the resources it needs to put on diameter growth at a much faster rate.
- Crop trees are usually dominant or codominant in the stand, a minimum of 25 feet tall, have large healthy crowns, and are free from undesirable defects.
- A minimum of 20-50 crop trees per acre should be released. More potential crop trees are typically present in younger stands.
- Area wide thinning can occur in the area between crop trees.

TABLE 2. STOCKING GUIDES FOR EVEN-AGED STANDS

TREE TYPE	MEAN STAND DIAMETER	BASAL AREA	NUMBER OF TREES PER ACRE	SPACE BETWEEN TREES (ft)
Northern Hardwoods	4	47	538	9
	6	59	304	12
	8	68	194	15
	10	73	135	18
	12	78	99	21
	14	88	83	23
	16	98	70	25
Paper Birch	4	59	681	8
	6	59	304	12
	8	59	170	16
	10	59	109	20
Upland Oaks	4	38	436	10
	6	52	258	13
	8	59	170	16
	10	66	121	19
	12	71	90	22
	14	74	70	25
Eastern White Pine, Spruces and Balsam Fir	16	85	60	27
	4	59	681	8
	6	86	436	10
	8	105	304	12
	10	121	222	14
	12	134	170	16
	14	143	135	18
	16	152	109	20

REFERENCES

- 1/ Leak, William B., Dale S. Solomon, and Stanley M. Filip. 1969. *A Silvicultural Guide for Northern Hardwoods in the Northeast*. USDA Forest Service Research Paper NE-143.
- 2/ Safford, L.O. 1983. *Silvi-cultural Guide for Paper Birch in the Northeast* (revised). USDA Forest Service Research Paper NE-535.
- 3/ Lancaster, Kenneth F. and William B. Leak, 1978. *A Silvicultural Guide for White Pine in the Northeast*. USDA Forest Service General Technical Report NE-41.
- 4/ Frank, Robert M., and John C. Bjorkbom. 1973. *A Silvicultural Guide for Spruce-Fir in the Northeast*. USDA Forest Service General Technical Report NH-6
- 5/ Leak, William B. 1981. *Do Stocking Guides in the Eastern United States Related to Stand Growth*. Journal of Forestry Vol. 79, 661-664.

- 6/ Maximum cubic volume growth may actually be obtained by using wider spacing for hardwoods and closer spacing for white pine.
- 7/ Blumenstock, Marvin. 1996. *Yankee Woodlot Bulletin #6 Working With It*. University of Maine Cooperative Extension Bulletin # 7079.
- 8/ Maine Forest Service Forest Fact Sheet. 1986. *Weeding Young Forests*